# FACTORS INFLUENCING LEARNING AND PROBLEM SOLVING IN SMALL GROUPS

BY

ALLEN STUART PENMAN

B.S., University of Illinois, 1947
M.S., University of Illinois, 1948

## AN ABSTRACT OF A THESIS

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF DOCTOR OF PHILOSOPHY IN CLINICAL PSYCHOLOGY
IN THE GRADUATE COLLEGE OF THE
UNIVERSITY OF ILLINOIS, 1951

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# FACTORS INFLUENCING LEARNING AND PROBLEM SOLVING IN SMALL GROUPS

The object of this research has been to obtain basic laws regarding learning in small, temporary groups of men, these generalizations to be sought through a number of observations and measurements shaped according to the following hypotheses: that the group performance will be related to the mean personality traits of the population, to the structure of the group, and to the variation of rewards.

The three major independent variables tested were two levels of intelligence, two forms of leadership, and four reward patterns. The two forms of leadership were "leaderless," or groups in which the leadership that exists must emerge spontaneously, and is not formally recognized by the experimenter; and "formal leadership," or groups in which the leader is elected by the other members of the group during the first session, and the leader is then given instructions designed to create an "autocratic" atmosphere. The four reward patterns were: (1) equally divided, in which each member of the winning group was to receive an equal share; (2) leader-weighted, in which the leader's share was two and one-half times greater than that of the other members; (3) scaled reward, in which the amount each member received was to be determined by the number of votes cast for him by the other members of the group as "contributing the most to the progress of the group;" and (4) the same as (1) except that the amount was doubled. A measurement was made of the relation of these independent variables to syntality by quantitative measurements of the actual group product, including both means and ends learning. Syntality is defined as the behavior of the group as a group.

Learning was defined as a change in syntality when the group is exposed to a certain environmental situation, and a measurement was made of two types of changes that may

appear during the process of learning: (1) greater effectiveness with which a group reaches a goal, i.e., means learning, and (2) changes in the nature of the total group satisfaction at which the group aims, i.e., goal learning. A leader was defined as a person who has a demonstrable influence upon group syntality, and the effectiveness of the two forms of leadership was measured by the magnitude of the syntality change produced by them.

The basic research design called for sixteen groups of six men each in order to have one group for each of the sixteen different combinations formed by the three major independent variables. The population consisted of freshmen and sophomore volunteers from the rhetoric classes. On the basis of the intelligence scale of the PF-16 personality questionnaire constructed by R. B. Cattell, eight groups of "low" intelligence, and eight groups of "high" intelligence were formed, with all the groups within each subdivision of eight groups having approximately the same mean on this scale. Each of these groups met for three three-hour sessions spaced approximately one week apart. During the first session the groups had two trials on each of the three tasks, and three trials were made on each task during the second and third sessions. Intragroup relationships were measured by means of sociometric procedures and group member ratings after each trial on the tasks. The three tasks were (1) crypt-anagrams, in which the group solved as many coded anagrams as it could within ten minutes, (2) a motor task termed "dynamometer tracing," and (3) activity choice, in which the group had to choose from a list of nine activities, such as "eating a hot dog," "coffee," and "listening to music," one that it must do *as a group* for ten minutes.

The effects of the three major independent variables on the learning scores of each of the three tasks were then tested for significance by the use of the triple classification analysis of variance design.

The only variable approaching significance in the crypt-

anagram situation was the level of intelligence. All other main and interaction effects were found to be insignificant, and so a double classification analysis of variance was carried out which revealed the level of intelligence to be significant at the .05 level for both gain scores and per cent gain.

A test of the effect of the three main variables on the dynamometer tracing task indicated no significant main effects, but the interaction between intelligence and leadership was found to be significant just short of the .01 level of significance with respect to per cent gain; for the gain score the interaction of reward and leadership was found to be significant between the .05 and .01 level, and the interaction of intelligence and leadership was between the .01 and .001 level of significance. Visual inspection of the data revealed this trend to be in the following direction: the greatest gain was achieved by groups with "high" intelligence and formal leadership, but the "leaderless" groups of "low" intelligence gained more than groups with "low" intelligence and a formal leader.

The analysis of variance conducted on the activity choice situation failed to reveal any main or interaction effects for gain in satisfaction, per cent gain of satisfaction, or fairness of decision.

The group variables were then intercorrelated by means of rank difference correlation because of the small number of groups and crudeness of the scores used. These correlations were analyzed by examination of single linkage lists for correlations of .50, or larger, with the learning scores, and a cluster analysis was carried out with respect to the learning scores.

All of the personality scores were measured by means of the PF-16 Personality Questionnaire referred to previously on page 2. Cluster 1 revealed that gain in performance on crypt-anagrams is associated with greater motivation, more mutual criticism, and the personality factor of intellectual interest. Gain in performance in the dynamometer tracing is associated

with greater leader content, and the personality factor of independent self-sufficiency. With respect to the activity choice situation, Cluster 3 reveals the enjoyment gain score to be negatively associated with the personality factors of emotional stability, adventurous cyclothymia, and self-sufficiency. Cluster 4 indicated that the mean enjoyment for all eight trials was associated positively with the ratings by the members on fairness of the group's decision, interest of the members in keeping the group together as a group, and freedom of expression; it was negatively associated with the amount of mutual criticism within the group and the personality factor of nervous tension. In Cluster 2, the time taken for the group to make its choice from the various activities was found to be positively associated with scores on the personality factors of worrying suspiciousness and nervous tension, and negatively correlated with emotional stability.

The conclusions from this study were as follows:

(1) A general conclusion is that measurements can be made of *group* products.

(2) The effect on learning of the independent variable of two levels of intelligence seems even more significant when it is considered that the range of intelligence between the "high" and "low" groups was very small, and, presumably, this range is located in the upper level of the intelligence distribution for the population as a whole. The effect of this group variable on group syntality appears dependent upon the particular task or problem involved, and also upon the nature of the group structure, i.e., form of leadership. It appears to manifest itself principally by means of more effective methods and organization.

(3) The effect of different reward patterns upon the performance of the group was slight. The only noticeable trend, and this was statistically insignificant except for one exception, i.e., interaction of reward and leadership for the gain score in the dynamometer situation, was that groups in which

the leader received the bulk of the reward tended to gain less than groups under the other three patterns.

(4) The effect of the two forms of leadership was found to be significant only in interaction with intelligence in the dynamometer situation. That this effect of leadership became apparent in this situation, as compared with the crypt-anagrams, seemed dependent upon the nature of the tasks. In the crypt-anagrams situation, the groups tended to organize themselves regardless of whether or not they had a formal, elected leader, and no constant direction throughout the entire trial was required as in the case of the dynamometer tracing. The results of this study appear to support the notion that the situation determines the degree and type of leadership.

(5) The three major independent variables were found to exert no effect upon synergic or goal learning. The experiment does demonstrate, however, that such learning does occur, and that it can be measured. The amount of learning occurring was found to be related to the population personality traits.

(6) The study offers some evidence for the eventual predictability of certain group dimensions through the knowledge of the population personality traits, and has indicated the practicality of the total behavior approach.

## VITA

Allen Stuart Penman was born on June 16, 1920, in Williston, North Dakota. After graduating from Williston High School in 1938, he entered the University of Kentucky. After completing one year of undergraduate work at that institution, he entered the University of Illinois. After two years of additional undergraduate work at that institution, he enlisted in the Army of the United States in 1942, and served in the American and European Theaters. After being discharged form the Army in 1945, he re-entered the University of Illinois, receiving a Bachelor of Science Degree in February, 1947. At that time he began his graduate work and was also appointed a trainee in the Veterans Administration Training Program for Clinical Psychologists. He received the Master of Science Degree from the University of Illinois in 1948 and completed the four-year training program in clinical psychology in June, 1951.